CLAIMS

We claim:

1. A percutaneous apparatus, comprising:

an elongated percutaneous electrode having a first segment with a sharp first end, and a second segment with a second end, at least part of the second segment being configured to resiliently return toward a neutral position, the at least part of the second segment being spaced apart from at least part of the first segment by a separation distance when in the neutral position; and

a coupling member having an aperture, the aperture having an electrically conductive portion, the aperture being sized to removably receive the at least part of first segment and the at least part of the second segment in contact with the electrically conductive portion.

2. The percutaneous apparatus of claim 1, wherein the aperture has a diameter smaller than the separation distance.

3. The apparatus of claim 1, wherein the first segment and the second segment are formed from a single conductive member, the single conductive member having a bend of approximately 180 degrees or more between the first end and the second end.

4. The apparatus of claim 1, wherein the percutaneous electrode includes a resilient, conductive material with at least one of the first and second segments being movable relative to the other, and wherein the conductive material has a first configuration when the at least part of the first segment is spaced apart from the at least part of the second segment by a first distance, the conductive material further having a second configuration with the at least part of the first segment spaced apart from the at least part of the second segment by a second distance less than the first distance, the conductive material being elastically changeable from the first configuration to the second configuration.

5. The apparatus of claim 1, further comprising:

a housing with the percutaneous probe movably received in the housing; and

an attachment device coupled to the housing and releasably coupleable to a recipient's skin.

6. A percutaneous apparatus, comprising:

a percutaneous electrode having a first segment with a sharp first end and a second segment with a second end, at least part of the first segment being aligned along an axis, at least part of the second segment being offset from the axis; and

a coupling member having an aperture, the aperture having an aperture wall with at least a portion of the aperture wall being electrically conductive, the aperture being sized to removably receive the at least part of the first segment and the at least part of the second segment, with the at least part of the first segment and the at least part of the second segment in contact with the electrically conductive portion of the aperture wall.

7. The apparatus of claim 6, wherein the percutaneous electrode includes a resilient, conductive material with at least one of the first and second segments being movable relative to the other, and wherein the conductive material has a first configuration when the at least part of the first segment is spaced apart from the at least part of the second segment by a first distance, the conductive material further having a second configuration with the at least part of the first segment spaced apart from the at least part of the second segment by a second distance less than the first distance, the conductive material being elastically changeable from the first configuration to the second configuration.

8. A percutaneous apparatus, comprising:

an elongated percutaneous electrode having a first segment with a sharp first end and a second segment with a second end, at least part of the second segment being configured to resiliently return toward a neutral position, the at least part of the second segment being spaced apart from at least part of the first segment by a separation distance when in the neutral position; and

a housing carrying the percutaneous electrode, with the percutaneous electrode being movable relative to the housing between a stowed position with the first end positioned within the housing, and at least one deployed position with the first end positioned external to the housing.

9. The method of claim 8, further comprising a coupling member having an aperture, the aperture having an aperture wall with at least a portion of the aperture wall being electrically conductive, the aperture being sized to removably receive the at least part of the first segment and the at least part of the second segment in contact with the electrically conductive portion of the aperture wall.

10. A percutaneous apparatus, comprising:

a percutaneous electrode having a first segment with a first end, the percutaneous electrode further having a second segment with a second end spaced apart from the first end, the first segment being aligned along a first axis, the second segment being aligned along a second axis offset from the first axis, the percutaneous electrode having an at least approximately 180 degree bend between the first and second ends; and

a coupling member having an aperture, the aperture having an aperture wall with at least a portion of the aperture wall being electrically conductive, the aperture being sized to removably receive the first and second segments of the percutaneous electrode and the at least approximately 180 degree bend with the first and second segments in contact with the electrically conductive portion of the aperture wall.

11. A percutaneous apparatus, comprising:

a percutaneous electrode having a first segment with a sharp first end and a second segment with a second end, at least part of the first segment being aligned along an axis, at least part of the second segment being offset from the axis;

a coupling member having an aperture, the aperture having an aperture wall with at least a portion of the aperture wall being electrically conductive, the aperture being sized to removably receive the at least part of the first segment and the at least part of the second

segment, with the at least part of the first segment and the at least part of the second segment in contact with the electrically conductive portion of the aperture wall;

a conductive coupler in electrical communication with the conductive portion; and

a control unit coupled to the conductive coupler and configured to transmit, receive or transmit and receive electrical signals via the conductive coupler.

12. The apparatus of claim 11, wherein the percutaneous electrode is a first percutaneous electrode, the coupling member is a first coupling member and the conductive coupler is a first conductive coupler, and wherein the apparatus further comprises:

a second percutaneous electrode;

a second coupling member removably coupled to the second percutaneous electrode; and

a second conductive coupler connected between the second coupling member and the control unit.

13. A method for operating a percutaneous apparatus, comprising:

moving at least one of a percutaneous electrode and an electrically conductive coupler relative to the other to receive a portion of the percutaneous electrode in an aperture of the conductive coupler;

contacting first and second segments of the percutaneous electrode with a conductive portion in the aperture while at least a part of the first segment of the percutaneous electrode faces toward at least a part of the second segment of the percutaneous electrode; and

deploying the percutaneous electrode into a recipient's tissue.

14. The method of claim 13, further comprising aligning the electrically conductive coupler and the percutaneous electrode on a motion axis, and wherein moving at least one of the percutaneous electrode and the conductive coupler includes moving the at least one of the percutaneous electrode and the conductive coupler along the motion axis.

15. A method for operating a percutaneous apparatus, comprising:

moving at least one of a percutaneous electrode and a conductive coupler relative to the other to receive a portion of the percutaneous electrode in an aperture of the conductive coupler;

rotating at least one the conductive coupler and the percutaneous electrode relative to the other to engage first and second segments of the percutaneous electrode with a conductive portion in the aperture while at least part of the first segment faces toward at least part of the second segment; and

inserting the percutaneous electrode into a recipient's skin.

16. The method of claim 15, wherein receiving a portion of the percutaneous electrode in an aperture of the conductive coupler includes receiving the portion of the percutaneous electrode in an aperture having a non-axisymmetric cross-sectional shape.

17. A method for operating a percutaneous apparatus, comprising:

releasably attaching a housing to a recipient's skin, the housing carrying a percutaneous electrode, the percutaneous electrode having a first segment with a sharp first end and a second segment with a second end spaced apart from the first end with at least part of the first segment aligned along a first axis and at least part of the second segment being aligned along a second axis offset from the first axis;

aligning an electrically conductive coupler and the percutaneous electrode along a motion axis;

moving at least one of the percutaneous electrode and the conductive coupler relative to the other to receive the first and second segments of the percutaneous electrode in an aperture of the conductive coupler;

forcing at least one of the first and second segments toward the other by engaging both the first and second segments with a conductive wall of the aperture; and

moving the first end of the percutaneous electrode from a stowed position with the first end positioned within the housing to a deployed position with the first end positioned external to the housing.

18. An apparatus for percutaneous application, comprising:

a housing including a first portion having a first axis and a second portion having a second axis, the first portion being coupled to the second portion and movable between a first position and a second position relative to the second portion, wherein the first axis is generally parallel to the second axis when the first portion is in the first position, and wherein the first axis is generally transverse to the second axis when the first portion is in the second position; and

a percutaneous probe disposed in the housing and movable along the first axis.

19. The apparatus of claim 18, wherein:

the first portion is movably coupled to the second portion by a ball and socket connection; and

the housing further includes a locking device to selectively restrict movement of the first portion relative to the second portion.

20. The apparatus of claim 18, wherein:

the housing further includes a flexible portion coupled to the first and second portions to permit relative motion between the first and second portions; and

the flexible portion includes a material that is deformable from a first configuration to a second configuration and configured to retain its shape when in the second configuration.

21. The apparatus of claim 18, further comprising an actuator carrying the percutaneous probe, the actuator being movable relative to the housing between a first actuator position with the percutaneous probe in a stowed position and a second actuator position with the percutaneous probe in a deployed position.

22. An apparatus for percutaneous application, comprising:

a percutaneous probe movable along an axis between a stowed position and a deployed position; and

a housing including a first portion and a second portion movably coupled to the first portion, the second portion having a distal end with a surface defining a plane, wherein the first portion is movable between a first position in which the axis has a first angular orientation relative to the plane and a second position in which the axis has a second angular orientation relative to the plane, the second orientation being different than the first orientation, and wherein the percutaneous probe is disposed in the housing.

23. The apparatus of claim 22, wherein:

the housing further includes a flexible portion coupled to the first and second portions to permit relative movement between the first and second portions; and

the flexible portion includes a material having memory.

24. The apparatus of claim 22, further comprising:

an actuator carrying the percutaneous probe and being movably disposed in the housing, the actuator having a receiving portion; and

an actuator tool having an engaging portion configured to removably engage the receiving portion of the actuator.

25. An apparatus for percutaneous application through a recipient's skin, comprising:

a percutaneous probe; and

a housing having a first portion and a second portion coupled to the first portion, the first portion being movable relative to the second portion to orient the percutaneous probe for insertion into the recipient's skin at a selected angle of less than 90 degrees relative to the recipient's skin, wherein the percutaneous probe is disposed in the housing.

26. An apparatus for percutaneous application through a recipient's skin, comprising:

a housing including a first portion and a second portion coupled to the first portion, the second portion including a surface configured to be positioned at least proximate to the recipient's skin; and

a percutaneous probe movably disposed in the housing, wherein the first portion of the housing is movable relative to the second portion so that the percutaneous probe is orientable for insertion into the recipient at a plurality of angles relative to the recipient's skin.

27. The apparatus of claim 26, further comprising an attachment device coupleable to the housing to attach the apparatus to the recipient's skin.

28. A method for operating an apparatus for percutaneous application, comprising:
positioning a housing at least proximate to a recipient's skin;

moving a first portion of the housing relative to a second portion of the housing to orient a percutaneous probe at a selected angle of less than 90 degrees relative to the recipient's skin;

inserting a portion of the percutaneous probe into the recipient at the selected angle;
withdrawing the percutaneous probe from the recipient; and

stowing the percutaneous probe in the housing.

29. The method of claim 28, wherein:

moving the first portion relative to the second portion includes flexing a flexible portion of the housing that is coupled to the first and second portions of the housing; and

the method further comprises selectively restricting movement of the flexible portion after moving the first portion relative to the second portion.

30. A method for operating an apparatus for percutaneous application, comprising:

moving a first portion of a housing relative to a second portion of the housing so that a first axis of the first portion is transverse to a second axis of the second portion;
positioning the housing at least proximate to a recipient;

inserting a percutaneous probe into the recipient at a selected angle;

withdrawing the percutaneous probe from the recipient; and

stowing the percutaneous probe in the housing.

31. The method of claim 30, wherein moving the first portion relative to the second portion includes flexing a flexible portion of the housing that is coupled to the first and second portions of the housing.

32. An apparatus for percutaneous application, comprising:

a housing having a probe portion disposed around a probe axis, the housing further having a non-planar support surface configured to face toward a recipient's skin, the support surface having an exit aperture;

a percutaneous probe having a sharp end and being movably positioned in the probe portion of the housing, the percutaneous probe being movable along the probe axis relative to the housing between a stowed position with the sharp end located within the housing and a deployed position with the sharp end deployed through the exit aperture; and

an attachment device depending from the housing and configured to releasably attach the housing to the recipient's skin.

33. The apparatus of claim 32, wherein the support surface is contoured relative to a flat plane extending transverse to the probe axis.

34. The apparatus of claim 32, wherein the probe portion of the housing includes a generally cylindrical portion projecting from the support surface, and wherein the support surface extends radially outwardly from the probe portion, further wherein the attachment device includes an adhesive attached to the support surface.

35. The apparatus of claim 32, further comprising:

an actuator disposed within the housing, the actuator carrying the percutaneous probe and being movable relative to the housing along the probe axis; and

an actuator tool releasably engageable with the actuator to move the actuator and the percutaneous probe relative to the housing.

36. An apparatus for percutaneous application, comprising:

a housing having a probe portion disposed around a probe axis, the housing further having a support surface configured to face toward a recipient's skin, the support surface having an exit aperture and having a shape that is asymmetric with respect to the probe axis;

a percutaneous probe having a sharp end and being movably positioned in the probe portion of the housing, the percutaneous probe being movable along the probe axis relative to the housing between a stowed position with the sharp end located within the housing and a deployed position with the sharp end deployed through the exit aperture; and

an attachment device depending from the housing and configured to releasably attach the housing to the recipient's skin.

37. The apparatus of claim 36, wherein the probe portion of the housing includes a generally cylindrical portion projecting from the support surface, and wherein the support surface extends radially outwardly in an asymmetric manner from the probe portion, further wherein the attachment device includes an adhesive layer attached to the support surface.

38. The apparatus of claim 36, further comprising:

an actuator disposed within the housing, the actuator carrying the percutaneous probe and being movable relative to the housing along the probe axis; and

an actuator tool releasably engageable with the actuator to move the actuator and the percutaneous probe relative to the housing.

39. An apparatus for percutaneous application, comprising:

a housing having a probe portion disposed around a probe axis, the housing further having a contoured support surface configured to face toward a recipient's skin and having a shape that is asymmetric relative to the probe axis, the support surface having an exit aperture;

a percutaneous probe having a sharp end and being movably positioned in the probe portion of the housing, the percutaneous probe being movable along the probe axis relative

to the housing between a stowed position with the sharp end located within the housing and a deployed position with the sharp end deployed through the exit aperture; and

an attachment device depending from the housing and configured to releasably attach the housing to the recipient's skin.

40. An apparatus for percutaneous application, comprising:

a housing having a probe portion disposed around a probe axis, the housing further having a flexible support member with a support surface configured to face toward a recipient's skin, the support member having an exit aperture and being deflectable from a neutral position in two opposing directions toward the probe axis;

a percutaneous probe having a sharp end and being movably positioned in the probe portion of the housing, the percutaneous probe being movable along the probe axis relative to the housing between a stowed position with the sharp end located within the housing and a deployed position with the sharp end deployed through the exit aperture; and

an attachment device depending from the housing and configured to releasably attach the housing to the recipient's skin.

41. The apparatus of claim 40, wherein the support surface is deflectable from a contoured neutral plane.

42. The apparatus of claim 40, wherein the support surface is contoured relative to a flat plane extending transverse to the probe axis and wherein the support surface has a shape that is asymmetric relative to the probe axis.

43. An apparatus for percutaneous application, comprising:

a first percutaneous unit that includes:

a first housing having a first support surface configured to face toward the recipient's skin, with the first support surface having a first size and shape; and

a first percutaneous probe having a sharp end and being movably positioned in the first housing, the first percutaneous probe being movable relative to the first housing

between a stowed position and a deployed position, the first percutaneous probe being coupleable to a control device to control signals transmitted via the first percutaneous probe; and

a second percutaneous unit that includes:

a second housing having a second support surface configured to face toward the recipient's skin, with the second support surface having a second size and shape and with the second size being different than the first size, or the second shape being different than the first shape or both; and

a second percutaneous probe having a second sharp end and being movably positioned in the second housing, the second percutaneous probe being movable relative to the second housing between a stowed position and a deployed position, the second percutaneous probe being coupleable to the control device simultaneously with the first percutaneous probe to control signals transmitted via the second percutaneous probe.

44. The apparatus of claim 43, further comprising:

the control unit;

a first conductive link electrically coupled between the control unit and the first percutaneous unit; and

a second conductive link electrically coupled between the control unit and the second percutaneous unit.

45. An apparatus for percutaneous application, comprising:

a housing having a probe portion disposed around a probe axis, the housing further having a contoured support surface configured to face toward a recipient's skin, the support surface having an exit aperture;

a percutaneous probe having a sharp end and being movably positioned in the probe portion of the housing, the percutaneous probe being movable along the probe axis relative to the housing between a stowed position with the sharp end located within the housing and a deployed position with the sharp end deployed through the exit aperture;

an attachment device depending from the housing and configured to releasably attach the housing to the recipient's skin;

a control unit;

an electrically conductive link releasably coupled between the control unit and the percutaneous probe.

46. The apparatus of claim 45, wherein the housing is a first housing having a first support surface, and wherein the percutaneous probe is a first percutaneous probe, and wherein the apparatus further comprises a second housing having a second contoured support surface and carrying a second percutaneous probe, the first and second percutaneous probes being simultaneously coupled to the control unit.

47. A method for operating a percutaneous apparatus, comprising:

placing a first percutaneous probe housing on a recipient's skin, the first percutaneous probe housing carrying a first percutaneous probe and having a first support surface facing toward the recipient's skin generally transverse to the first percutaneous probe, the first surface being non-axisymmetric relative to the first percutaneous probe and having a first orientation relative to the recipient's spine;

deploying the first percutaneous probe from the first housing into the recipient's skin;

placing a second percutaneous probe housing on the recipient's skin, the second percutaneous probe housing carrying a second percutaneous probe and having a second support surface facing toward the recipient's skin generally transverse to the second percutaneous probe, the second surface being non-axisymmetric relative to the second probe and having a second orientation relative to the recipient's spine, with the second orientation different than the first orientation; and

deploying the second percutaneous probe from the second housing into the recipient's skin.

48. The method of claim 47, wherein the first support surface is elongated along a first axis and the second support surface is elongated along a second axis, further wherein placing the first percutaneous probe housing on a recipient's skin includes positioning the first axis at a first angular orientation relative to the recipient's spine, and wherein placing the second percutaneous probe housing on a recipient's skin includes positioning the second axis at a second angular orientation relative to the recipient's spine, the second angular orientation being different than the first angular orientation.

49. A method for operating a percutaneous apparatus, comprising:
aligning a housing with a recipient's skin surface, the housing carrying a percutaneous probe aligned along a probe axis;

positioning a support member of the housing at least proximate to the skin surface, with the support member of the housing further having a support surface facing toward the skin surface;

orienting the support surface to at least approximately match a contour of the skin surface;

releasably attaching the housing to the skin surface; and
deploying the percutaneous probe from the housing into the skin surface.

50. A method for operating a percutaneous apparatus, comprising:
selecting a site on a recipient's skin surface;

selecting one of a first percutaneous device and a second percutaneous device based at least in part on the selected site, the first percutaneous device having a first housing carrying a first percutaneous probe that is movable along a first probe axis, the first housing further having a first support surface configured to face toward the recipient's skin, the first support surface having a first configuration, the second percutaneous device having a second housing carrying a second percutaneous probe that is movable along a second probe axis, the second housing further having a second support surface configured to face toward the recipient's skin, the second support surface having a second configuration different than the first configuration;

releasably attaching the one of the first and second percutaneous devices to the recipient's skin at the selected site and deploying a corresponding one of the first and second percutaneous probes into the recipient's skin; and

coupling the one of the first and second percutaneous devices to a control unit.

51. The method of claim 50, wherein selecting one of the first and second percutaneous devices includes selecting the one of the first and second percutaneous devices based at least in part on the recipient's body size.

52. A method for operating a percutaneous apparatus, comprising:

positioning a percutaneous device at least proximate to a recipient's skin, the percutaneous device including a housing carrying a percutaneous probe, the percutaneous probe being movable relative to the housing along a probe axis, the housing further having a flexible support surface configured to face toward the recipient's skin;

flexing the support surface relative to the probe axis to change a shape of the support surface from a first shape to a second shape;

releasably attaching the housing to the recipient's skin with the support surface having the second shape and facing and at least proximate to the skin surface; and

deploying the percutaneous probe into the recipient's skin.

53. The method of claim 52, wherein flexing the support surface includes flexing the support surface to at least approximately match a contour of the recipient's skin at a location where the housing is attached to the skin.